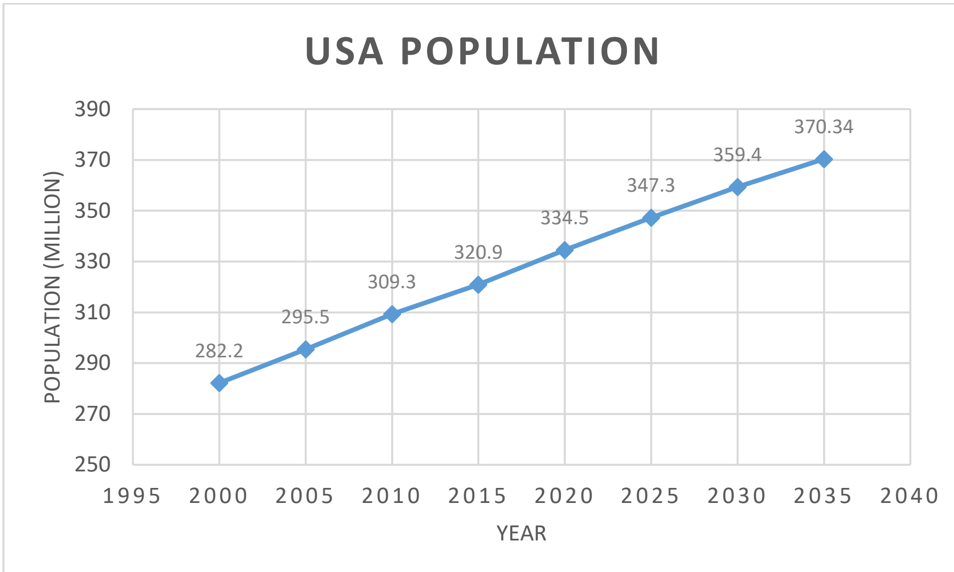
ME 444 Assignment #2 Carina Grady

1. Using United States Census Bureau for past results and Statista for projected results, the following graph can be obtained:

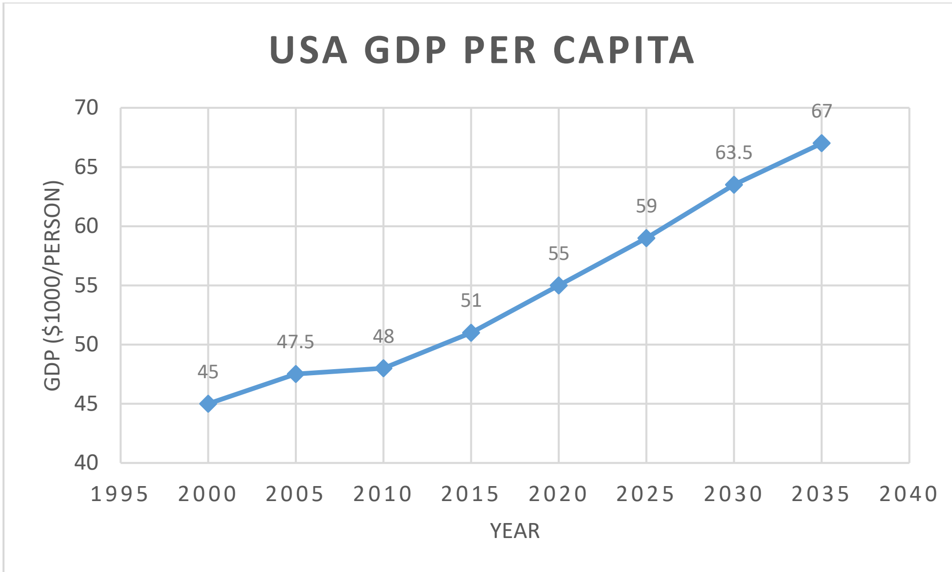


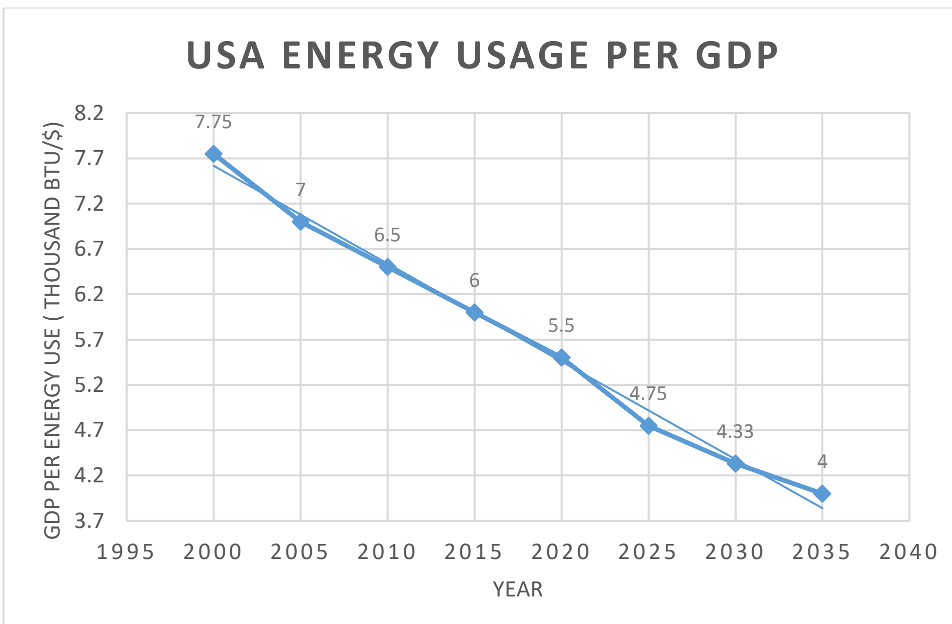
The population of 2017 is 326.47 million. Thus, the ANNUAL growth rate from 2017 to 2035 can be calculated:

$$Growth\ rate = \frac{326.47 - 370.34}{370.34 * 18} = 6.58\%$$

2. According to a graph from the EIA, the US GDP has been steadily increasing since 1975, with the exception of a small mishap occurring during the Recession. . I am not able to direct find data from the EIA, but I was able to find an energy intensity graph from the EIA with the data. I used my best judgement to determine specific points. I predict that the US GDP will linearly increase from 2017 to 2035, while energy intensity will linearly decrease.

The following graphs show my predictions. Years 2020 to 2035 are my estimated extrapolations.

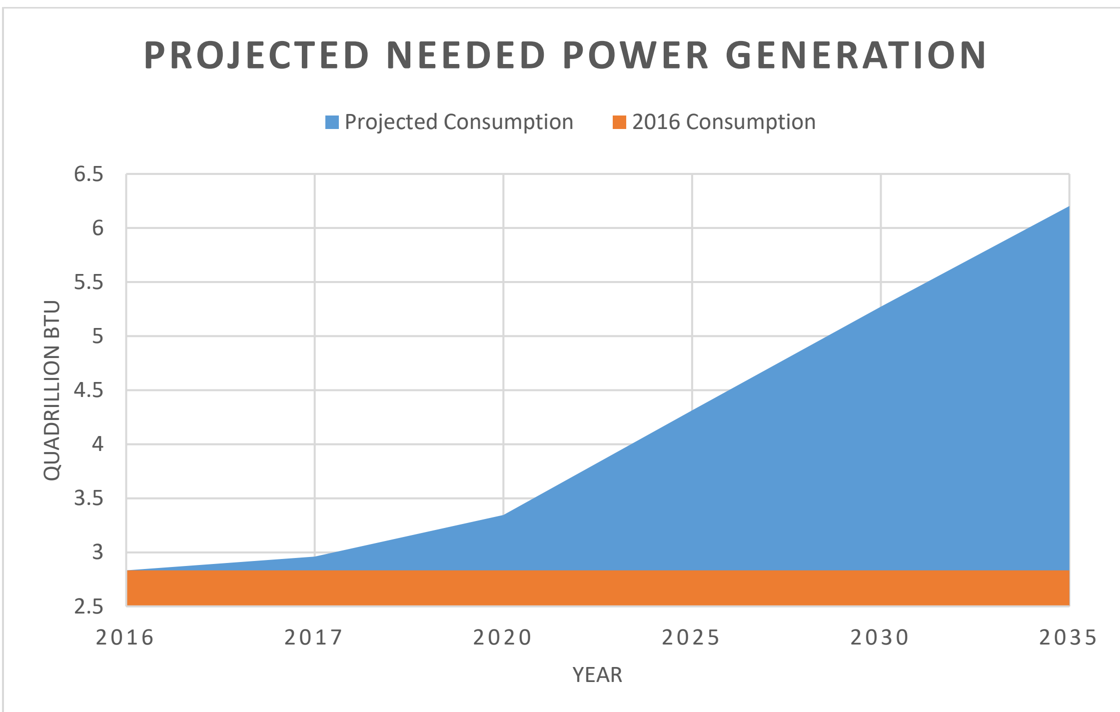




3. The unit for GDP is $1000/person. The unit for energy usage per GDP is $/thousand-Btu. Thus, dividing GDP by energy usage per GDP will result in 1 million Btu/person. To get total energy use, population corresponding to the year must be multiplied. The following table can be produced using above formula, accounting for prefix units.

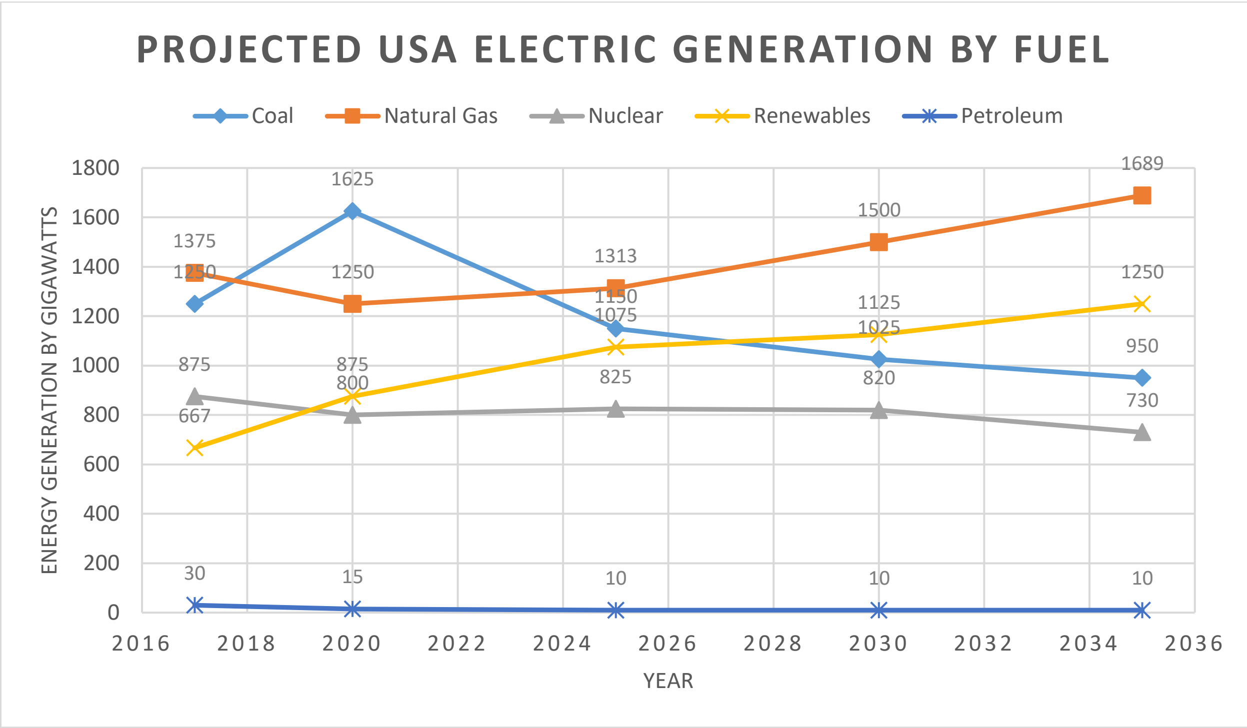
YEAR	TRILLION BTU OF ENERGY
2017	2.961
2020	3.345
2025	4.314
2030	5.271
2035	6.203

4. According to EIC, 2016's total energy consumption was 97.41 quadrillion Btu. I suspect that there is error in my data since 2016 and 2017 has such a big gap between the numbers of Btu consumed. This could be for a number of reasons, with a notable one having to essentially guess what the numbers are, even for past numbers since the EIA did not include specific points. In other words, "eye-balling" data will result in error. I also suspect that GDP and energy consumption are *not* linearly correlated. For the purpose of this assignment, I will assume the table above is accurate, and I will extrapolate the number for 2016 so that I can assume (given my data above) that the energy consumption that year is 2.83 quadrillion Btu. Thus, this much new power will be needed:



Adding all the area in the shaded blue part of the graph represents the additional area needed until 2035, which is 29.35 quadrillion Btu.

5. The EIA split the energy consumption by the following five areas for electricity: coal, petroleum, natural gas, nuclear, and renewable energy. The EIA provides a graph with their projections, and so I am able to "eye-ball" the exact values, which, again, leads to error. I would like to add that I will be using their numbers of billion kilowatt-hours produced, and not the ones from questions 3 and 4. With this information in mind, the breakdown of electric generation by fuels is the following graph:



6. Unfortunately, there is not a “database” of power plants on the EIA for me to look at, so answering this question was a bit tricky. I needed to know how many plants were present in 2017 and with what capacity, but I was unable to find that database anywhere. I was, however, able to find the count of electric industry power plants in the US, published by the EIA. For the sake of this assignment, I will use averages. In other words, I will find the average plant per GW generated of each fuel by taking number of plants present to 2017, and then dividing it by the 2017 fuel’s electric generation (question #4). I do this for all fuels, every year, then tally up the results for 2025 and 2035, with my results in the following tables (petroleum was omitted due to relatively constant change).

Coal: 0.3048 plant/GW
Natural Gas: 1.3098 plant/GW
Nuclear: 0.0697 plant/GW
Renewables: 5.433 plant/GW

Pluses (+) indicate new plants, and minuses (-) indicate closing of plant. Using the corresponding plant/GW and the predicted energy generated for each fuel, the following table can be produced:

Power Plant	**2017 - 2020**	**2020 - 2025**	**2025 - 2030**	**2030 - 2035**
Coal	+114	-167	-38	-23
Natural Gas	-163	+83	+245	+248
Nuclear	-5	+2	0	-6
Renewables	+723	+1087	+272	+679

Tallying the totals up, by 2025 and 2035, the following table shows the number of plants that will open/close, measuring by the decade:

Power Plant	**2025**	**2035**
Coal	-53	-61
Natural Gas	-81	+493
Nuclear	-3	-6
Renewables	+1810	+951